Digital Output Module
MR-DO4
110836132101 with manual control facility

MR-DOA4
110836132101 without manual control facility

1. Description
The Modbus modules with 4 digital outputs are designed for local switching operations. They are suitable to operate electrical loads (RC-element for high inductive loads). The outputs can be operated via a Modbus-Master. Setting of the outputs is 00 (reserved for broadcast commands).

Continuation Description
Communication with the master can be monitored with a watch-dog timer. If master or communication fail the outputs are switched to their basic state (secure state) and the red LED is lighting. The timer starts with each valid message addressed to the device. When defining the time constant it is necessary to take account of the baud rate, the number of slaves on the bus and the length of the messages per slave.

2. Declaration of Conformity
The device was tested according to the applicable standards. Conformity was proofed. The declaration of conformity is available at the manufacturer METZ CONNECT GmbH.

Notes Regarding Device Description
These instructions include indications for use and mounting of the device. In case of questions that cannot be answered with these instructions please consult supplier or manufacturer.

Safety Instructions
Keep the applicable directions for industrial safety and prevention of accidents as well as the VDE rules. Technicians and/or installers are informed that they have to be familiar with the device before installation or maintenance of the devices. Only qualified personnel shall do mounting and installation work with the devices, see section “qualified personnel”. The information of these instructions have to be read and understood by every person using this device.

Symbols
Warning of dangerous electrical voltage

Danger
means that non-observance may cause risk of life, grievous bodily harm or heavy material damage.

Qualified Personnel
Qualified personnel in the sense of these instructions are persons who are well versed in the use and installation of such devices and whose professional qualification meets the requirements of their work.

This includes for example:
- Qualification to connect the device according to the VDE specifications and the local regulations and a qualification to put this device into operation, to power it down or to activate it by respecting the internal directions.
- Knowledge of safety rules.
- Knowledge about application and use of the device within the equipment system etc.

3. Technical Data

<table>
<thead>
<tr>
<th>Modbus Interface</th>
<th>Protocol</th>
<th>Modbus RTU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission rate</td>
<td>1200 to 115200 Bd (factory setting 19200 Bd Even)</td>
<td></td>
</tr>
<tr>
<td>Cabling</td>
<td>RS485 two wire bus with voltage equalizing cable in bus / line topology</td>
<td></td>
</tr>
</tbody>
</table>

| Supply          | Operating voltage range | 20 to 28 V AC/DC (SELV) |
|                | Current consumption     | 200 mA (AC) / 70 mA (DC) |
|                | Relative duty cycle     | 100 % |

| Output          | Output contacts | 4 x changeover contacts |
|                | Switching voltage max. | 250 V AC |
|                | Continuous current max. | 5 A per relay |
|                | Total current for all contacts | 12 A |
|                | Switching frequency | 360 switching cycles per hour |

| Housing        | Dimensions WxHxD | 1.4 x 2.8 x 2.6 in. (35 x 70 x 65 mm) |
|                | Weight | 95 g |
|                | Mounting position | any |
|                | Mounting standard rail TH35 per IEC 60715 |
|                | Mounting in series without space | the maximum quantity of modules connected in line is limited to 15 or to a maximum power consumption of 2 Amps (AC or DC) per connection to the power supply. For any similar block of additional modules a separate connection to the power supply is mandatory. |

| Material        | Housing | Polyamide 6.6 V0 |
|                | Terminal blocks | Polyamide 6.6 V0 |
|                | Cover plate | Polyamide 6.6 V0 |
|                | Type of protection (IEC 60529) | Polyamide 6.6 V0 |
|                | Housing | IP40 |
|                | Terminal blocks | IP20 |

| Terminal blocks | Supply and bus 4 pole terminal block | max. AWG 16 (1.5 mm²) solid wire |
|                | max. AWG 18 (1.0 mm²) stranded wire |
|                | min. 0.3 mm up to max. 1.4 mm (terminal block and jumper plug are included to each packing unit) |

| Module connection | Input/Output | max. AWG 12 (4.0 mm²) solid wire |
|                  | max. AWG 14 (2.5 mm²) stranded wire |
|                  | min. 0.3 mm up to max. 2.7 mm (polarity reversal protection of operating voltage) |

| Wire diameter     | max. AWG 12 (4.0 mm²) solid wire |
|                  | max. AWG 14 (2.5 mm²) stranded wire |

| Protective circuitry | polarity reversal protection of supply and bus |

| Temperature range | Operation | -5 °C to +55 °C |
|                  | Storage | -20 °C to +70 °C |

| Display           | Operating and bus activity green LED |
|                  | Error indication | red LED |
|                  | Status of the outputs | yellow LED |

4. Wiring Diagram

5. Connection Diagram
6. Mounting

**DANGER**
Risk of death by electric shock!
Switch off all electrical power supply before starting work on energized parts.

The device can be snapped on to a TH35 rail. To remove the device from the rail, unblock the snap-on foot with a screwdriver.

Device connection according to wiring diagram. Strip the wires by 7 mm, put on wire end sleeves, insert them into the terminal body and fix them with an appropriate screwdriver.

**Plug in the terminal block for bus connection**

1. Connect the cable for bus supply
2. Mounting in series

The module can be aligned without interspace. Use the jumper plug to connect bus and supply voltage when the modules are mounted in series.

The maximum quantity of modules connected in line is limited to 15 or to a maximum power consumption of 2 Amps (AC or DC) per connection to the power supply. For any similar block of additional modules a separate connection to the power supply is mandatory.

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7. Bit rate and Parity setting

The bit rate and parity can be set in the programming mode when jumper is plugged behind the front cover of the module. This jumper is removed in normal mode. A connection to the bus is not required during bit rate setting.

The bit rate of the modules can be set in the following way:

1. remove the front cover of the module;
2. plug a jumper to the two middle pins of the 4 pole header between the red and green LED (0);
3. set the desired parity and bit rate with the address switches (0) in accordance to the chart below.

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8. Software description

8.1 I/O commands

**_01 (0x01) Read Coils_**

**Request**

- Valid Coil Starting Address 0 .. 7
- for MR-DDA4 Address 4 .. 7 = 0
- Valid Quantity of Outputs 1 .. 8

**Response**

- Byte Count
- Output Status

<table>
<thead>
<tr>
<th>Bit</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Status relay 1 off</td>
</tr>
<tr>
<td>1</td>
<td>Status relay 1 on</td>
</tr>
<tr>
<td>2</td>
<td>Status relay 2 off</td>
</tr>
<tr>
<td>3</td>
<td>Status relay 2 on</td>
</tr>
<tr>
<td>4</td>
<td>Status relay 3 off</td>
</tr>
<tr>
<td>5</td>
<td>Status relay 3 on</td>
</tr>
<tr>
<td>6</td>
<td>Status relay 4 off</td>
</tr>
<tr>
<td>7</td>
<td>Status relay 4 on</td>
</tr>
</tbody>
</table>

**_05 (0x05) Write Single Coil_**

**Request**

- Valid Output Address 0 .. 3
- Valid Output Value 0x0000 or 0xFF00

**Response**

- Echo of the request

**_15 (0x0F) Write Multiple Coils_**

**Request**

- Valid Coil Starting Address 0 .. 3
- Valid Quantity of Outputs 1 .. 4
- Valid Byte Count 1
- Output Value 0 or 1 in Bit0 .. Bit3

**Response**

- Function Code, Starting Address, Quantity of Outputs

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Continuation Software description

**“_03 (0x03) Read Holding Registers_”**

**Request**

- Valid Register Starting Address 0 .. 1 or 66
- Valid Quantity of Registers 2 or 1

**Response**

- Function Code, Byte Count, Register Values

**Values Register 0:**

**Bit Information**

<table>
<thead>
<tr>
<th>Bit</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Initial state after Reset or communication monitoring relay 1 off</td>
</tr>
<tr>
<td>1</td>
<td>Initial state after Reset or communication monitoring relay 1 on</td>
</tr>
<tr>
<td>2</td>
<td>Initial state after Reset or communication monitoring relay 2 off</td>
</tr>
<tr>
<td>3</td>
<td>Initial state after Reset or communication monitoring relay 2 on</td>
</tr>
</tbody>
</table>

**Values Register 1:**

**Bit Information**

<table>
<thead>
<tr>
<th>Bit</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Status relay 1 off</td>
</tr>
<tr>
<td>1</td>
<td>Status relay 1 on</td>
</tr>
<tr>
<td>2</td>
<td>Status relay 2 off</td>
</tr>
<tr>
<td>3</td>
<td>Status relay 2 on</td>
</tr>
<tr>
<td>4</td>
<td>Status relay 3 off</td>
</tr>
<tr>
<td>5</td>
<td>Status relay 3 on</td>
</tr>
<tr>
<td>6</td>
<td>Status relay 4 off</td>
</tr>
<tr>
<td>7</td>
<td>Status relay 4 on</td>
</tr>
</tbody>
</table>

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**Time constant for communication monitoring.**

Register Value = 0 (0x0000) (default) there is no communication monitoring. All other values are for communication monitoring with a solution of 10 ms.

- 0x0001 to 0xFFFF => 0.01 to 655.35 seconds = 10.9 minutes
Continuation Software description

"06 (0x06) Write Single Register"
Request
Register Address: 0 or 1 or 66
Register Value: Bits 0 – 3 according to tables or the description above
Response
Echo of the request

"16 (0x10) Write Multiple Registers"
Request
Valid Register Starting Address 0 or 1
Valid Quantity of Registers 2
Byte Count 2 x Quantity of registers
Registers Value: Quantity of registers x 2 Byte
Bits 0 – 3 according to tables
Response
Function Code, Register Starting Address, Quantity of Registers

8.2 Bit rate setting with Modbus command
Parity and bit rate have the same value as when setting them by address switch.
If Parity or Bit has the value 0, no setting or storage is carried out.
The register content is stored in the EEPROM.

"06 (0x06) Write Single Register"
Request
Valid Register Address: 0x41 (65)
Valid Register Value: 2 Bytes

<table>
<thead>
<tr>
<th>Bit</th>
<th>15</th>
<th>14</th>
<th>12</th>
<th>11</th>
<th>10</th>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x53</td>
<td>Parität</td>
<td>Bitrate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bit 15-8: Magic-Number 0x53 = 83 as protection against accidental writing.
The command will be further analysed only with this number.

Bit 7-4: 1 2 3
Parität: even odd none

Bit 3-0: 1 2 3 4 5 6 7 8
Bitrate: 1200 2400 4800 9600 19200 38400 76800 153600

Response
Echo of Request

Example for a frame:
Slave address: 0x12 - Setting of rotary switch (18)
Function: 0x06 - Write Single Register
Register address Hi: 0x00
Register address Lo: 0x41 - Bit rate and parity (65)
Register contents Hi: 0x53 - Magic-Number
Register contents Lo: 0x05 - Parity Even, 19200 Baud

All devices can be switched simultaneously with a Broadcast command (Slave address 0x00).
However, it is advised not to do so as this can cause problems:
- Devices from other manufacturers may have under this address a register for a different purpose that will then be operated in the wrong way.
- There is no feedback from the individual devices. Consequently the control cannot immediately recognize if the command was correctly received.

Continuation Software description

It is safer to address and switch each device individually.
The device will then answer with the old settings of parity and bit rate. Switching will take place only afterwards. However, the answer can get lost if the bus is disturbed.

When all devices are switched, it is advised to check communication.
Any function of the device providing a feedback is suitable.
If a single function is to be used being independent from the process periphery then the function “Diagnostic” sub-function „Return Query Data“ is suitable, it returns the transferred data.

If bit rate and parity setting of a device are unknown it is possible to address the device successively with all combinations of bit rate and parity until the device answers. Try the most likely combinations first. Try the lower bit rates last as they take longer.

8.3 General commands

“08 (0x08) Diagnostics”
Subfunction “70 (0x0000) Return Query Data”
Data Field Any
Response: Echo of Request
Subfunction “1 (0x0001) Restart Communication Option”
Data Field 0x0000 oder 0xF000
Response: Echo of Request
Action: Clears all Error Counters, Restarts node
Subfunction “4 (0x0004) Force Listen Only Mode”
Data Field 0x0000
No Response
Action: No response until Node Reset or Function Code 08 Subcode 01
Subfunction “7 (0x0008) Clear Counters”
Data Field 0x0000
Response: Echo of Request
Action: Clears all Error Counters
Subfunction “10 (0x000A) Return Bus Message Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “11 (0x000B) Return Bus Communication Error Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “12 (0x000C) Return Bus Communication Error Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “13 (0x000D) Return Bus Exception Error Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “14 (0x000E) Return Slave Message Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “15 (0x000F) Return Slave No Response Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “16 (0x0010) Return Slave Message Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “17 (0x0011) Return Slave No Response Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “18 (0x0012) Return Slave Exception Error Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “19 (0x0013) Return Bus Communication Error Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “20 (0x0014) Return Bus Exception Error Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “21 (0x0015) Return Bus Message Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “22 (0x0016) Return Bus Communication Error Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “23 (0x0017) Return Bus Exception Error Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “24 (0x0018) Return Slave Message Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “25 (0x0019) Return Slave No Response Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “26 (0x001A) Return Slave Exception Error Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “27 (0x001B) Return Bus Communication Error Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “28 (0x001C) Return Bus Exception Error Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “29 (0x001D) Return Bus Message Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “30 (0x001E) Return Bus Communication Error Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00
Subfunction “31 (0x001F) Return Bus Exception Error Count”
Data Field 0x0000
Response: Echo of Request
Action: No response until Node Reset or Function Code 08 Subcode 01
Data Field 0x0000 oder 0xFF00

"08 (0x08) Diagnostics"
Subfunction “1 (0x0001) Restart Communication Option"